air were studied, and the changes which they underwent when they encountered obstacles.

The apparatus for investigating these movements in air was of simple character; it consisted of a chimney of prismatic form (side 0·50 m., height 0·75 m.). The front side was made of clear glass, and the posterior wall was covered with black velvet; the left wall was white and the right one was glazed.

In front of the apparatus a lantern was placed within which a magnesium flash could be fired. A draught was maintained through the chamber by an electric fan. The flow of air was rendered steady by being filtered through silk gauze of fine mesh, placed at the top and at the bottom of the prismatic chamber. By a beautiful method M. Marey rendered the direction of currents of air visible; he introduced minute streams of smoke, which were drawn in with the aspirated air, and remained parallel to each other during their passage through the chamber when not opposed by any obstacle. The smoke was obtained from the combustion of tinder and cotton in a closed furnace; from this furnace the smoke was conducted to a series of narrow tubes parallel to one another.

When an obstacle was placed within the chamber the stream lines were seen to bend against the obstacle and divide into two currents, one of which flowed up the slope of the inclined plane, the other down it (Fig. 1). The division appeared to take place at a point which corresponded with the centre of pressure against the inclined plane. This point of separation was found to be at the middle point of the plane when the plane was horizontal, and to approach its upper end the more the plane was inclined. Behind the obstacle eddies were seen to form.

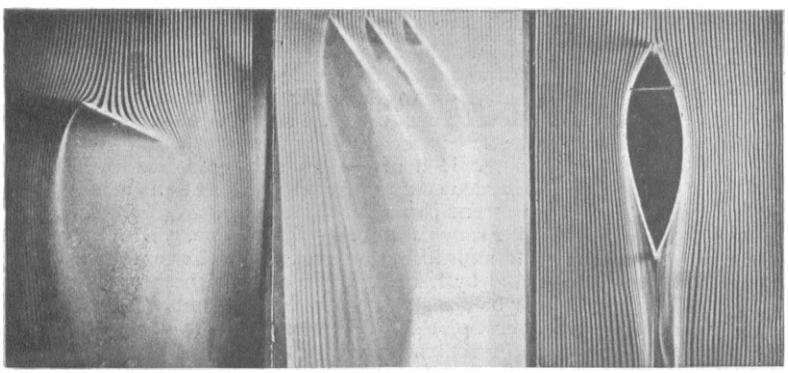

FIG. 1. FIG. 2. FIG. 3.

M. Marey found the velocity of the air streams, thus. By means of an electric vibrator he imparted vibrations to the smoke jet tubes, having a period of ten per second. The smoke streams then became sinusoidal in shape, the inflections being maintained during the whole length traversed by the smoke. The series of lateral inflections was measured by means of a divided scale placed in the same plane as the streams of smoke.

These inflections remained equidistant when the speed of the current remained constant, but when the speed was reduced the inflections were closer together, and farther apart when the speed of the streams was increased. M. Marey employed the magnesium flash to obtain his photograph; probably sharper pictures would have been obtained by using the electric spark from a charged Leyden jar as an illuminant.[1] M. Marey mentions that an important question to be answered in the science of aërial flight is, How do air currents behave when passing through adjacent parallel planes inclined at an angle to the stream? Fig. 2 answers the question clearly. The picture will suggest much to those engaged in the designing of kites of the *box* type, where the air strikes against more than one plane.

The conditions of stream line flow round different aquatic animals have received considerable attention, and we know that a blunt head and a pointed tail is a favourable arrangement. By immersing solid bodies having one end obtuse and the other pointed, it is observable that there is a great advantage in presenting the large end to the direction of motion; this minimises the motion of the air behind the body. The same phenomenon is to be seen in air. Fig. 3 shows that, with the large end facing the stream, the disturbance in the rear of the object is slight, only small eddies being set up. M. Marey's methods are applicable to an almost endless variety of similar experiments on the stream lines of air round differently shaped bodies. M. Marey's paper is short and condensed, but it contains matter of much importance, and is another example of the beautiful results obtained by this master of experimental methods in chronography.

F. J. J.-S.

[1] Spark photography of objects in rapid movement (smoke jets and smoke rings photographed in collision).—Junior Scientific Club, Oxford; NATURE, vol. xlvii. p. 119.

THE VENTILATION OF THE TUBES.

IN October, 1901, the London County Council determined to investigate the condition of the atmosphere in the tube of the Central London Railway, in order to ascertain how far the threatened multiplication of underground tubes might affect the public health. As the result of this, the chemist to the County Council, in conjunction with Dr. Andrewes, made a chemical and bacteriological examination of the condition of the atmosphere in the tunnels, stations, carriages, and lifts of the Central London Railway, as compared with the outside air under ordinary conditions. As might have been expected, it was shown by the experiments that the fluctuations in the amount of carbon dioxide and organic matter present in the tube were very great.

Examination in the early morning showed that the ventilation employed had produced a very fair condition of air, whilst during the hours of traffic the carbon dioxide rose to considerably higher limits than existed in the outer atmosphere. The County Council chemist considers that samples of air taken at any point on the railway should not contain more than double the amount which is found in the air of the streets, inasmuch as the additional carbon dioxide found in the air of the tunnels has been entirely produced by respiration, and is therefore accompanied by organic matter.

This report was submitted to the Council on February 17, but its reception was postponed, as it is clearly one of those cases in which extreme caution should be used in arriving at conclusions, and introducing rules and regulations which might hamper important developments in the relief of our over-congested traffic.

The normal quantity of carbon dioxide present in the air is a little under four volumes in ten thousand, and the sanitary limit, which is universally adopted for the atmosphere in our dwelling-houses, is six parts in ten thousand in rooms which are to be inhabited for any

length of time, this being fixed on the assumption that the organic matter in the air increases at the same ratio as the carbon dioxide, but it is evident that this limit may be exceeded without damage to health when such atmosphere is only to be inhaled for a short period.

On examining the report of the Public Health Committee, it will be noticed that the carbon dioxide was highest in the air of the carriages, and that the air in the lifts also contained a larger quantity of carbon dioxide than the passages leading to them, showing that, as might have been expected, the enclosed areas in which respiration was taking place contained the largest quantity of carbon dioxide.

Before it can be assumed from this that the impurities found are due to want of ventilation in the tube, it should be clearly shown what the comparison is between the carbon dioxide and organic matter present in a carriage on the tube, and a carriage (say) on the North London Railway during the busy hours of traffic, or even in some London theatres towards the close of a performance, and it will probably be found that the difference which exists is very small indeed.

The real hygienic value of the report centres in Dr. Andrewes's summary of his results, in which he concludes that while micro-organisms are present in the tube air in a somewhat greater proportion than in fresh air, *i.e.* 13 to 10, the excess is not so considerable as to cause the tube air to compare unfavourably with the conditions known to exist in inhabited rooms generally. The highest averages of micro-organisms were found in carriages and lifts, *i.e.* in the most crowded places examined, whilst the platforms and passages came out actually better than the fresh air, the tunnels being only a little worse.

If we consider this as well as the fact that the Central London Railway Company is taking steps to improve the ventilation of the tunnels by installing a large rotary fan at the Shepherd's Bush end powerful enough to draw out the whole of the air in the tunnels three times over during the period in which traffic is stopped, and is installing at the Bank station an air compressor for forcing fresh air into the extreme end of the Bank sidings, it seems clear that the facts of the case do not call for any active interference on the part of the authorities, especially after the atmosphere existing in the Metropolitan Railway between (say) King's Cross and Baker Street has been patiently endured for so many years.

FIG. 1.—South-East portion of Zaidan City, showing how it disappears under distant sand accumulations. (From Landor's "Across Coveted Lands.")

THROUGH PERSIA AND BALUCHISTAN.[1]

UNDER a somewhat quaint title, Mr. Landor describes a journey through Persia and Baluchistan to India. He is a keen observer, and, throughout his two large volumes, he writes pleasantly of his experiences on the road, and of much that he saw and heard by the way. He is a little inclined to dwell upon the discomforts rather than upon the pleasures of travelling, and to get excited over "a prominent geographical society," "royal geographo-parasites," and "newspaper penny-a-liners," but he is always amusing. He gives his views with great frankness upon the social condition of Persia, so far as he became acquainted with it, and upon questions of trade, education, and politics. He writes strongly upon the struggle between England and Russia for political and commercial supremacy in the kingdom of the Shah, and gives a clear idea of the smartness with which Russia takes advantage of the slowness and mistakes of her adversary.

Mr. Landor travelled *viâ* Flushing, Warsaw, and Kiev to Baku; crossed the Caspian in a Russian steamer; and, after a sleepless night on a "living" mattress, entered Persian territory at Enzeli. Thence he proceeded to Resht, and drove along the carriage road to Teheran, where he was presented to the Shah, visited several of the Persian Ministers, was present at the birthday festivities, and saw all that is most worth seeing in the capital. An interesting lescription is given of the Shah's palace and gardens and, in some remarks on the Persian army, attention is drawn to the great difference between the "Russian-drilled Persian Cossacks" and the infantry soldiers. From Teheran Mr. Landor followed the post road to Isfahan, and thence travelled *viâ* Yezd to Kerman, where he visited the deserted city of Farmidan, and the "Ya Ali" inscription. From Kerman he turned north and crossed the salt desert, Dasht-i-Lut, to Birjand, passing on the way Naiband, of which place and its people many interesting details are given. In the desert he suffered, as others have done in desert countries, from heat and thirst by day, and from cold by night. But he appears to have been more than usually unfortunate in his camels, which do not seem to have been in good condition for a long desert journey, or to have been accustomed to hill work.

From Birjand Mr. Landor followed the well-known route through Sistan and Baluchistan to Quetta. He has much of interest to tell about the ruins of Zaidan, in Sistan, and gives several photographs of one section of them. But surely it is inappropriate to write of the place as "the ancient London of Asia," as if it were of extraordinary size and unusual grandeur. The ruins in themselves are not very imposing, and the view

[1] "Across Coveted Lands." By A. H. Savage Landor. 2 vols. Pp. xv + 927. (London: Macmillan and Co., Ltd., 1902.) Price 30s. net.